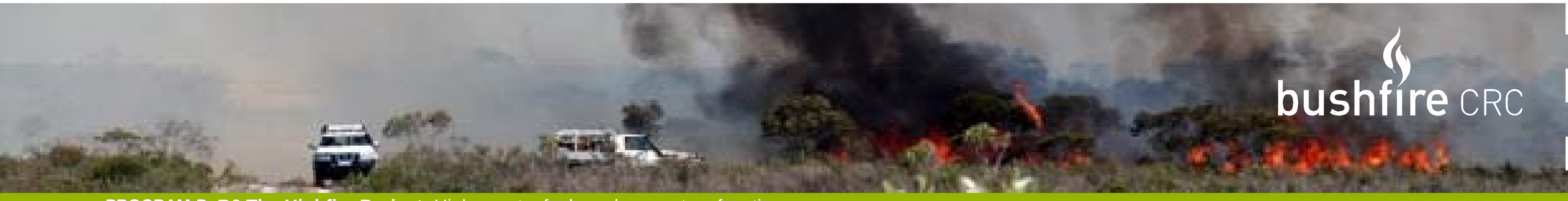

Alpine soil as a methane sink: controlling factors and fire effects

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Aerobic soils are important sinks of atmospheric CH_4

Soil bacteria, called methanotrophs, consume atmospheric methane (CH_4) via a process called CH_4 oxidation. The effects of fire on soil properties are relatively well known. Less is understood about the effects of changed soil properties on CH_4 oxidation.

This project aims to improve our understanding and ability to predict the effects of fire on CH_4 oxidation.

The feedback loop below shows that atmospheric CH_4 effects climate change, which then effects fire regimes, soil properties and soil conditions. Changes in the soil effects CH_4 oxidation rates which then effect atmospheric CH_4.

Sites: Alpine ash (*Eucalyptus delegatensis*) forest, Bogong High Plains, Victoria. Wildfires in 2003 and 2006 caused crown death of dominant trees in some areas and removal of the understorey vegetation in others.

Methods: Soil was incubated in the laboratory in specially modified jars. Soil properties of interest were altered and the changes in headspace CH_4 was measured and used to calculate CH_4 oxidation rates. Gas samples were analysed using gas chromatography.

Atmospheric CH_4

Atmospheric CH_4 has increased by 75% in the past 200 yrs. In the lab, CH_4 oxidation increased with increased CH_4 concentration for all soil layers, with the highest oxidation rates observed in soils from 5-10cm.

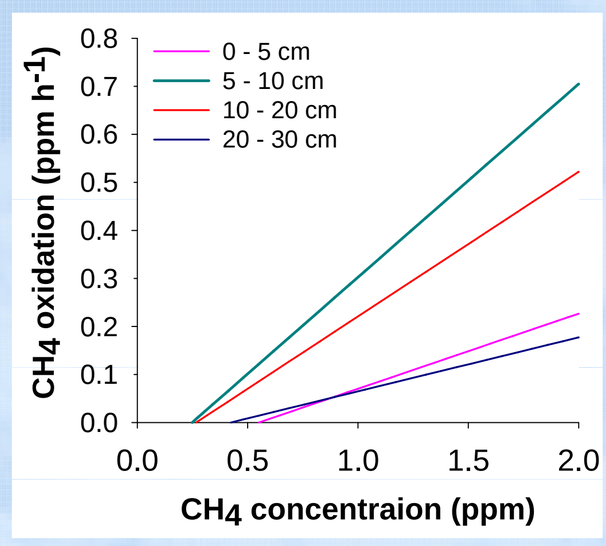

Figure 1: The effect of CH_4 concentration on CH_4 oxidation. Each line represents a different soil layer.

Fire

Fire alters soil properties. The fire frequency and intensity will determine the extent of these changes.

Climate change

Methane is an important greenhouse gas, contributing to 4-9% of the greenhouse gas effect (carbon dioxide contributes 4-26%).

Soil conditions

Soils conditions effects by climate change include temperature and moisture.

Temperature (results not shown), had little effect on CH_4 oxidation between the ranges of 5 to 25˚ C. Oxidation rates were slightly greater at 30˚ C.

Decreased precipitation leads to decreased **soil moisture**. Soil collected from the field for this study ranged between 30-45% water holding capacity Laboratory results showed this level was optimal for CH_4 oxidation.

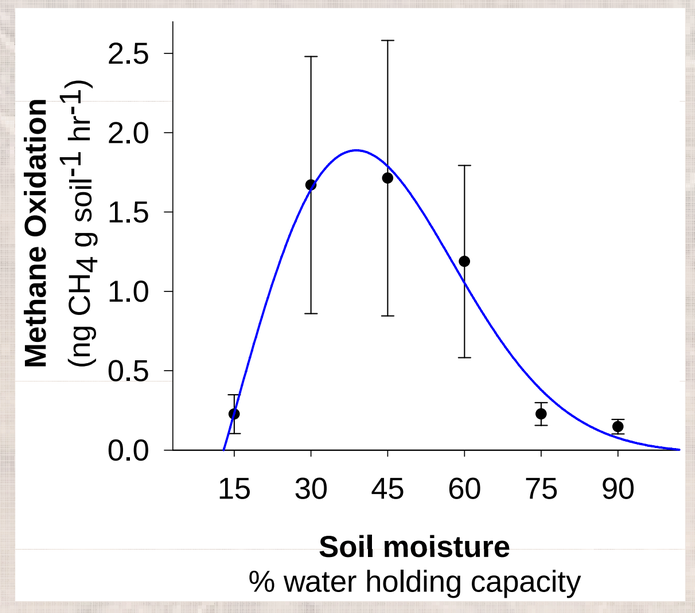

Figure 4: The effects of soil moisture on CH_4 oxidation. Each dot represents the mean of 10 samples and 3 replicates. Error bars are 95% CI.

Soil properties

Ammonium and pH are have been observed to increase after fire (pH becomes more basic).

Soil ammonium before fire varies between 7 to 40ppm. Laboratory results showed that ammonium inhibits CH_4 oxidation.

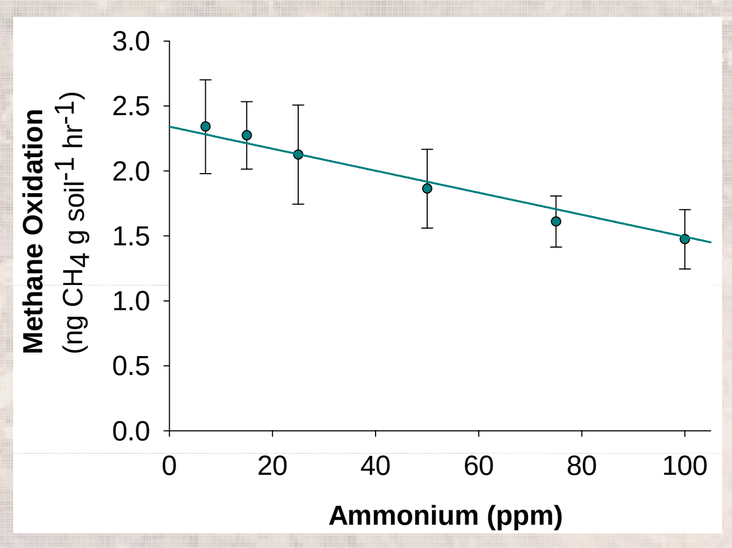

Figure 2: The effect of ammonium on CH_4 oxidation. Each dot represents the mean of 10 samples and 3 replicates. Error bars are 95% confident intervals (CI)

The **pH** of these soils before fire is around 4.5. An increase in pH would result in an increase in CH_4 oxidation until a pH of 6.

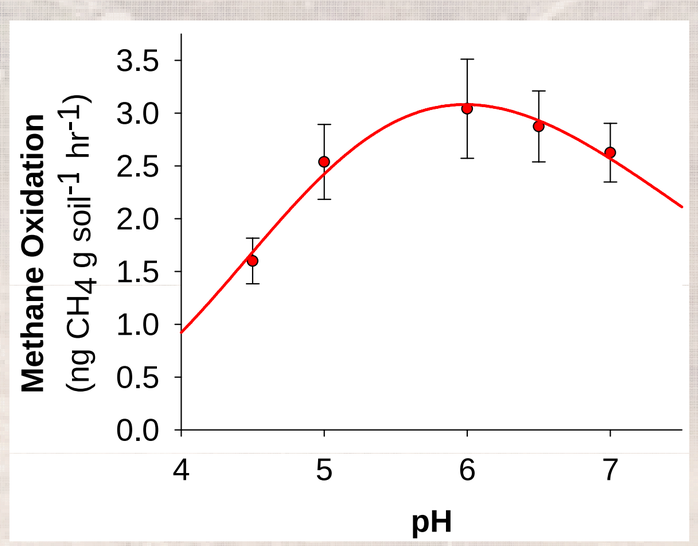

Figure 3: The effect of pH on CH_4 oxidation. Each dot represents the mean of 10 samples and 3 replicates. Error bars are 95% confidence intervals.

CH_4 oxidation rates

Methane oxidation rates in alpine soils are greatly effected by soil properties and conditions. However, this is a very complex system. To be able to predict how fire and climate change will alter this important sink, the effects of all soil properties needs to be combined, e.g. the decrease in oxidation due to increased ammonium after fire, may be counteracted by the increase in oxidation due to increased pH.

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